EIoT

Ch:01

The Microcontroller Architecture:

- Introduction to 8051 Microcontroller,
- Architecture,
- Pin configuration,
- Memory organization,
- Input /Output Ports,
- Counter and Timers,
- Serial communication,
- Interrupts

Why EIoT?

- Embedded system are everywhere from household appliances to automatic system.
- Embedded system and IoT this fields are complementary to each other.
- Microcontroller involved in many devices and connecting those devices is nothing but IoT.
- The integration of embedded system with IoT enables creation of smart devices from industry to smart home, health care devices and many more.

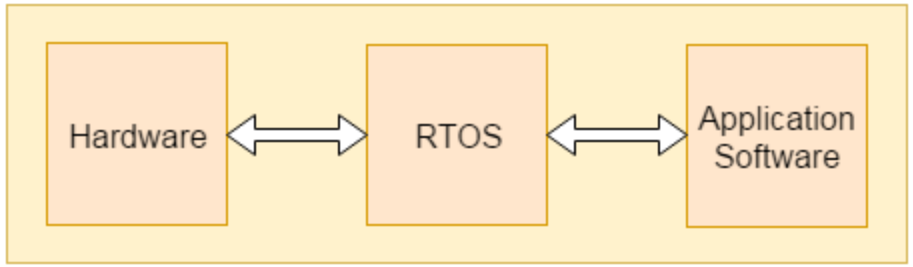
- System:
- System is a way of working, organizing or performing one or many tasks according to a fixed set of rules, program or plan.
- An Embedded System:
- An Embedded System is a system that has software embedded into computer-hardware, which makes a system dedicated for a variety of application or specific part of an application or product or part of a larger system.
- It is a microcontroller-based control system used to perform a specific task of operation.

An embedded system is a combination of three major components:

•**Hardware:** Hardware is physically used component that is physically connected with an embedded system. It comprises of microcontroller based integrated circuit, power supply, LCD display etc.

•**Application software:** Application software allows the user to perform varieties of application to be run on an embedded system by changing the code installed in an embedded system.

•**Real Time Operating system (RTOS):** RTOS supervises the way an embedded system work. It act as an interface between hardware and application software which supervises the application software and provide mechanism to let the processor run on the basis of scheduling for controlling the effect of latencies.



• Characteristics of Embedded System

- An embedded system is software embedded into computer hardware that makes a system dedicated to be used for variety of application.
- Embedded system generally used for do specific task that provide real-time output on the basis of various characteristics of an embedded system.
- Embedded system may contain a smaller part within a larger device that used for serving the more specific application to perform variety of task using hardware-software intermixing configuration.
- It provides high reliability and real-time computation ability.

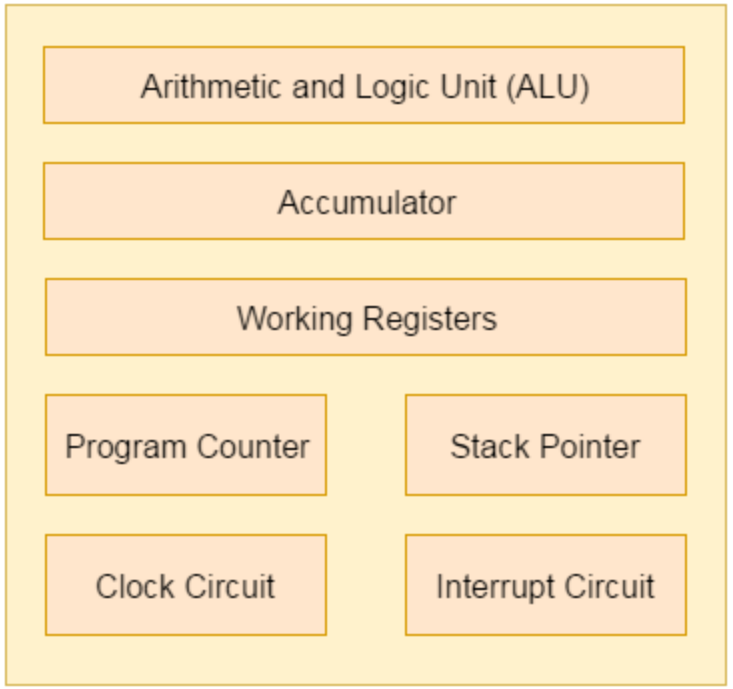
- **Advantages**
- Same hardware can be used in variety of application.(keep changing prg)
- Lesser power requirement
- Lower operational cost of system
- Provide high performance and efficiency
- **Disadvantages**
- Developing a system required more time. Due to functional complexity.
- Skilled engineers required because one mistake may result in destroying of complete project.

Embedded System processors

- **Processors inside a system:**
- Processors inside a system have two essential units:
- **Control unit**: This unit in processors performed the program flow control operation inside an embedded system. The control unit also acts as a fetching unit for fetching the set of instructions stored inside a memory.
- **Execution unit**: This unit is used for execution the various tasks inside a processors. It mainly comprises of arithmetic and logical unit (ALU) and it also include a circuit that executes the instruction sets used to perform program control operation inside processors.
- **Types of general purpose processor are:**
- Microprocessor
- Microcontroller
- Digital signal processor
- Analog signal processor

Microprocessor

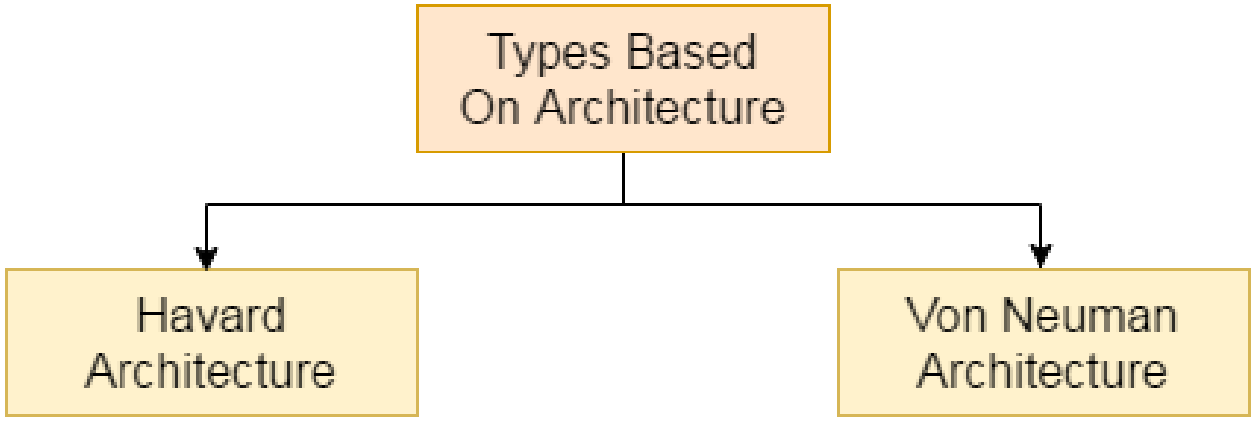
- A central processing unit built into a single VLSI chip is called a microprocessor. It is a general purpose device and an additional outside circuitry is added to make it work as a microcomputer.
- Operations performed by microprocessor are adding, subtracting, comparing two numbers and fetching the data from memory for transferring it from one place to another.
- Microprocessors is also called as Basic Input-Output system (BIOS) which used for processing the input received from sensors and produced the equivalent output from the system.



- **Let's see the basic components of microprocessor:**
- **Arithmetic and Logic unit (ALU)**: ALU inside a microprocessor used to perform the arithmetic and logic operation. It performs the logic operation on the data stored inside a register.
- **Accumulator**: It is a register inside which the intermediate arithmetic and logical operation data is stored.
- **Working registers**: It is a storage device used to store the data inside a microprocessor in different address location.
- **Program counter**: It is used for counting the number of program executed inside a microprocessor.
- **Stack pointer**: Stack pointer act as a pointer to the certain address. It is a register used to store the address of the last program request made by the processor inside a stack.
- **Clock circuit**: It is used for generate the clock pulse required as a reference signal for the microprocessor.
- **Interrupt circuit**: It is used for generating the interrupt signal when the higher priority process required to be served first on basis of priority by microprocessor.

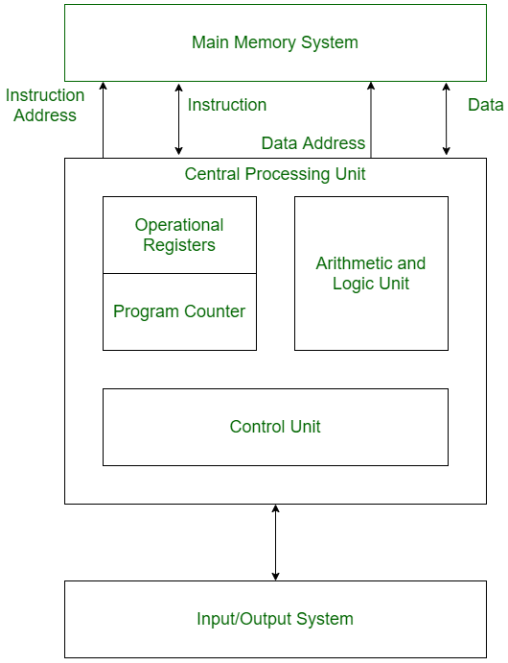
- A microcomputer made on a single semiconductor chip is called single-chip microcomputer. Since, single chip microcomputers are generally used in control applications, they are also called **microcontrollers**.

- Types of Microcontroller



1) Havard Architecture:

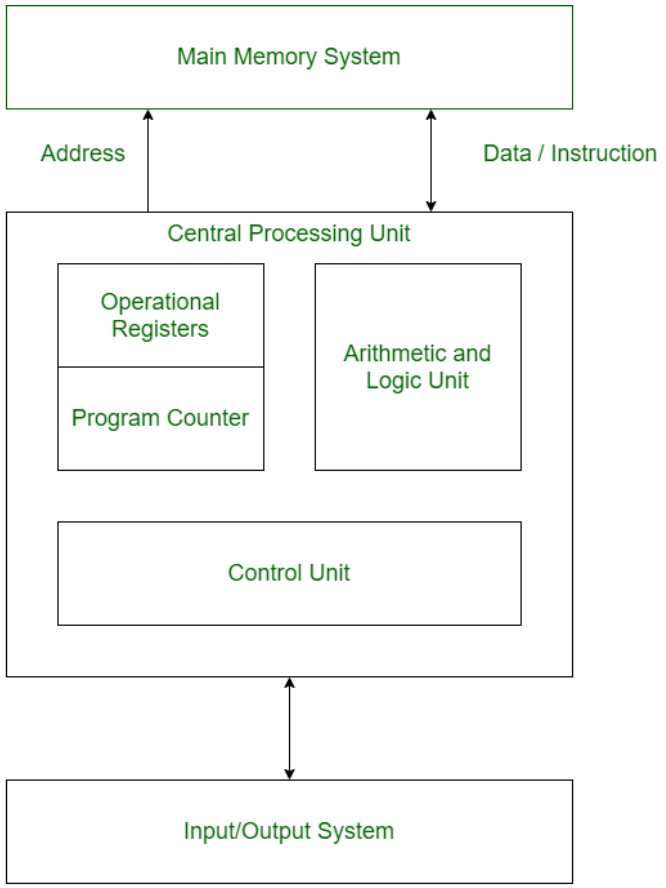
Harvard Architecture is the digital computer architecture whose design is based on the concept where there are separate storage and separate buses (signal path) for instruction and data. It was basically developed to overcome the bottleneck of Von Neumann Architecture. .



Harvard Architecture

2) **Von Neumann Architecture**:

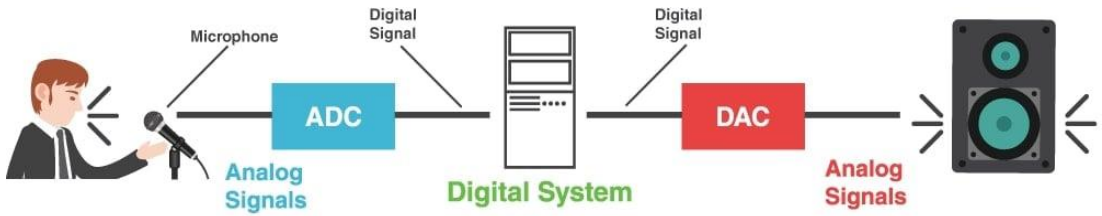
- Von Neumann Architecture is a digital computer architecture whose design is based on the concept of stored program computers where program data and instruction data are stored in the same memory. This architecture was designed by the famous mathematician and physicist **John Von Neumann** in 1945.

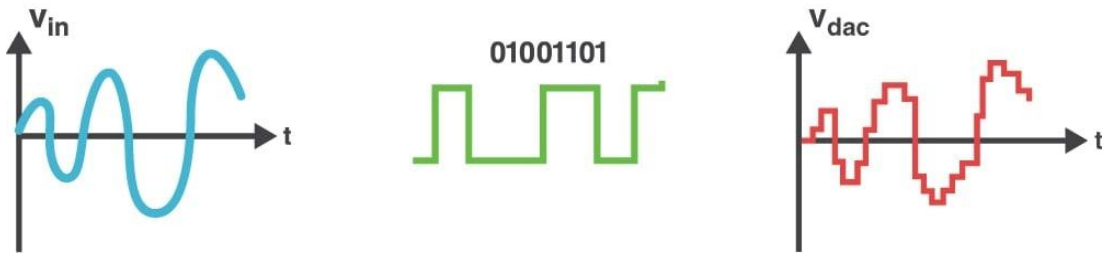


Von Neumann Architecture

S. No	Microprocessor	Microcontroller
1	Microprocessor acts as a heart of computer system.	Microcontroller acts as a heart of embedded system.
2	It is a processor in which memory and I/O output component is connected externally.	It is a controlling device in which memory and I/O output component is present internally.
3	Since memory and I/O output is to be connected externally. Therefore the circuit is more complex.	Since on chip memory and I/O output component is available. Therefore the circuit is less complex.
4	It cannot be used in compact system. Therefore microprocessor is inefficient.	It can be used in compact system. Therefore microcontroller is more efficient.
5	Microprocessor has less number of registers. Therefore most of the operations are memory based.	Microcontroller has more number of registers. Therefore a program is easier to write.
6	A microprocessor having a zero status flag.	A microcontroller has no zero flag.
7	It is mainly used in personal computers.	It is mainly used in washing machines, air conditioners etc.

- A **digital signal processor** (**DSP**) is a specialized microprocessor chip, with its architecture optimized for the operational needs of digital signal processing.
- They are widely used in audio signal processing, telecommunications, digital image processing, radar, sonar and speech recognition systems, and in common consumer electronic devices such as mobile phones, disk drives and high-definition television (HDTV) products.
- Analog signal processing is a type of signal processing conducted on continuous analog signals by some analog means.





Embedded System Tools and Peripherals

- **Compiler:**
- Compiler is used for converting the source code from a high-level programming language to a low-level programming language.
- **Cross-Compiler:**
- If a program compiled is run on a computer having different operating system and hardware configuration than the computer system on which a compiler compiled the program, that compiler is known as cross-compiler.
- Usually Application built for non-PC architecture (like embedded application running on ARM, PowerPC, MIPS architectures) use a cross compiler to generate an executable binaries.
- Cross Compilers must be specifically tailored for doing cross-compilation from the development machine (host), to embedded machine (target).
- **Decompiler:**
- A tool used for translating a program from a low-level language to high-level language is called a decompiler. It is used for conversion of assembly or machine code to high-level programming language.
- **Assembler:**
- Assembler creates an object code by translating assembly language instruction into set of mnemonics for representing each low-level machine operation.
- **Simulators:**
- Simulator is a tool used for simulation of an embedded system. Code tested for microcontroller unit by simulating code on the host computer. Simulator is used for model the behavior of the complete microcontroller in software.

- **Emulators:**
- An emulator is a software program or a hardware kit which emulates the functions of one computer system into another computer system. Emulators have an ability to support closer connection to an authenticity of the digital object.
- It can also be defined as the ability of a computer program in electronic device to emulate another program or device. It focusing on recreating the original computer environment and helps a user to work on any type of application or operating system.
- A simulator provides a fast and easy way to set up a software environment for application testing purposes without mimicking actual hardware.
- An emulator takes things a step further by emulating software as well as hardware configurations

Thank You